

ever, that the surviving types were cultivated twice on media free from chlorine before being again subjected to chlorination. A number of the colonies surviving several chlorinations were cultivated in lactose broth and the acidity determined quantitatively. All the cultures produced less acid than the original culture and the average was materially less than the original cultivated under the same conditions. This points to a diminution in the biochemical activity.

A point of perhaps more scientific interest than practical utility is the relative proportion of the various types of *B. Coli* found before and after treatment with chlorine. The writer, in 1914 commenced the analysis of the various types, using the division of the American

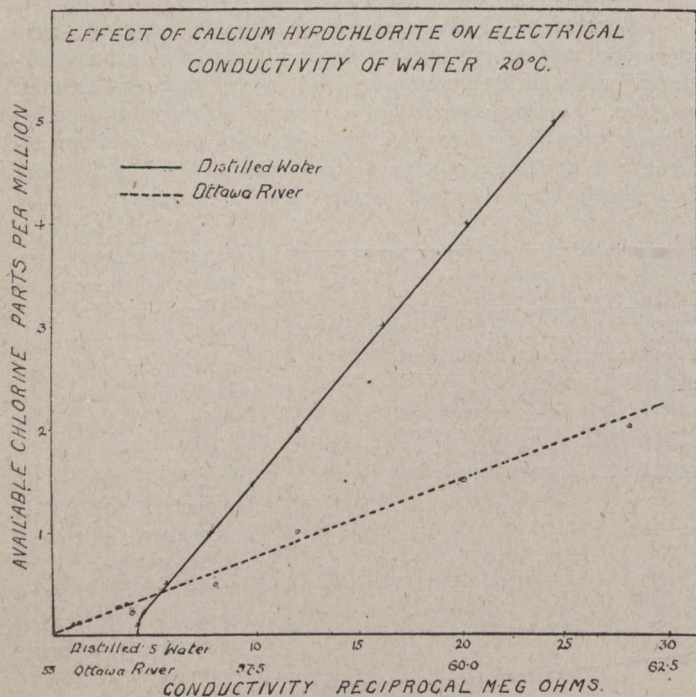


Diagram 3.

Public Health Association by dulcitate and saccharose as a basis. The averages of a large number of samples were as follows:—

	B. Coli Com-munis		B. Coli Com-munis		B. Lactis Aerogenes		B. Acidi Lactici	
	Raw Chlorinated.	Raw Chlorinated.	Raw Chlorinated.	Raw Chlorinated.	Raw Chlorinated.	Raw Chlorinated.	Raw Chlorinated.	Raw Chlorinated.
Ottawa, 1914	5	4	40	48	44	36	11	12
Ottawa, 1915	8	8	50	46	34	31	8	15
*Baltimore, 1913 ..	11	14	33	25	35	31	21	30

*Thomas and Sandman, J. Ind. and Eng. Chem, 1914. 6 p. 638.

Although there is a slight difference in the relative proportions of the types found at Ottawa and Baltimore, both sets of results show definitely that there is no difference in the resistance of the various types to chlorine.

The net earnings of the Manitoba Government telephones for the five months ended April 30, totalled \$202,571.41, according to the condensed earnings report and balance sheet recently issued by the public utilities commissioner.

Announcement has been made to the effect that the British Columbia Government will introduce legislation to provide \$200,000 for the purpose of opening up roads and trails to places in the mountains where there are "pioneer" prospects.

AGGREGATE STUDIES AT THE WINNIPEG AQUEDUCT.*

By James H. Fuertes.

THE Greater Winnipeg Water District is now building works for securing by gravity about 100,000,000 U.S. gallons of water per day from the Lake of the Woods, which lies about 100 miles east of, and some 300 ft. higher in elevation than, the city of Winnipeg.

Under the terms of the contract the District agrees to deliver the sand and gravel to the contractor at a stated price per cubic yard. Actually the District is shipping these mixed, but billed as sand and gravel in accordance with the ratios of the volumes that the sand and gravel would make separately, these having been determined from an extended laboratory study of the materials. It would be impossible, within space limits, to do justice to this phase of the subject. Owing to the percentage of sand in the gravel pit it is necessary to dig considerably more material than can be made into concrete aggregate. Thus in August there were excavated at the pit approximately 24,000 cu. yds. of material, of which 6,000 cu. yds. was stripping and 18,000 cu. yds. of sand and gravel; of the 18,000 cu. yds., 13,000 cu. yds. were concrete aggregate, a large proportion of which contained 50% of sand, and 5,000 cu. yds. was ballast and foundation fill material. It is desirable that the percentage of sand in the concrete aggregate should not exceed 35% of the whole in order to have an economical concrete. With a larger percentage of sand the amount of cement required to make a watertight concrete has to be increased. With a proper proportioning of the materials, particularly of the sand, by using certain percentages of sand passing the 100-mesh screen, it was possible to make concrete that was watertight under 80 lbs. pressure per square inch, with about 1 Canadian barrel (350 lbs.) of cement per cubic yard of concrete.

From a long series of samples of the materials from test pits in the gravel deposits at the pit it was found that the average run of the better samples contained about 3.3% of fine sand passing the 100-mesh sieve, the percentage of sand to total aggregate varying between quite wide limits. It was also recognized that it would be desirable from the point of view of economical development to use as large a proportion of sand in the final aggregate as safety would permit, bearing in mind that the amount of cement required to make tight concrete should be kept in a minimum. The allowable percentage of sand was finally fixed at 35% of the total aggregate, by weight, and the series of tests for permeability is based largely on this percentage, although a few tests were made with larger and smaller percentages.

Fig. 1, made up from the data obtained in the tests, shows the percentages of fine sand (passing the 100-mesh sieve) required to make watertight concrete with 10% of cement (370 lbs. of cement per cubic yard of set concrete) when the sand is 35% by weight of the total aggregate, with varying percentages of intermediate and coarse materials.

Using 12% cement, with sand having 3.3% passing the 100-mesh sieve, watertight concrete could be made with sand varying from 23% to 43% of total aggregate and with intermediate and coarse, in equal proportions varying from 77% to 57% respectively, or, if coarse were

*Extract from a paper read before the Western Society of Engineers.